CHAPTER 4: PATCHING AND EDGE REPAIR

1.0 DESCRIPTION

Patching, one of the most expensive of the maintenance procedures for hot-mix asphalt (HMA) pavements, (per unit of measure, i.e. cost/ton, cost/in^2, cost/yd^2) and is often done in preparation for other forms of corrective maintenance, pavement preservation, or pre-treatment prior to an overlay. Patching restores the pavement surface to a state where other preservation treatments can be used with a good chance of success.

The primary methods of patching include the replacement of materials that have been lost due to localized pavement distress or disintegration, the complete removal (dig out) and replacement of continuous segments of failed pavement, or the application of a thin layer of HMA material over segments of pavement that exhibit more surface-related distress/distortion. Once patched, the distressed area is repaired or strengthened so that it can carry a significant traffic level with improved performance and lower rates of deterioration.

Patching may be temporary, semi-permanent, or permanent treatments. The appropriate method to be used depends on the traffic level, the time of the year during which the repair is carried out, the time until scheduled rehabilitation, and the availability of equipment and personnel.

Patching is best carried out during clear moderate weather. However, emergency repairs may require patching be performed during poor winter weather conditions. In these instances, the durability of the patch is likely to be poor and the patch should be considered to be temporary. Accordingly, it is a good strategy to plan for a more semi-permanent repair of these areas when moderate weather conditions prevail.

This chapter is divided into pothole patching, material dig out and replacement, edge repair, and surface reinstatement. The procedures and materials associated with each method are addressed in a similar fashion.

1.1 PATCHING

Patching is a process in which the material in a highly distressed area is either removed and replaced or additional material is added to cover up the distressed area. Merely filling a hole will not prevent the development of distress adjacent to or within the patch in many instances. Maximum performance is achieved when the boundaries of the distressed area are appropriately marked and cut, the failed material is removed, the remaining (underlying) material is recompacted, the hole is properly prepared, and new material is added and compacted to a level similar to that for a new pavement.

The primary methods used to perform pothole patching are:

- Temporary
- Semi-Permanent
- Injection Patching (Not yet widely used in California)

The primary materials used for pothole patching are:

- Hot-mix asphalt (HMA) - preferred
- Cold-mix asphalt – temporary fix only
- Aggregate / asphalt emulsion combinations (i.e., injection patching)
- Special patching mixtures

1.2 DIG OUTS

Dig outs are used when the pavement has failed in localized areas too such an extent that even the underlying support materials have disintegrated, become infiltrated with fine-grained materials, or otherwise lost their load-carrying capacity. Unlike typical patching, dig outs require the removal and replacement of much (if not all) of the underlying base/sub base materials. Due to the thorough nature of this method, it has sometimes been referred to as spot reconstruction.

The main steps associated with dig outs are:

- Marking and cutting of the boundaries.
- Breakup and removal of the pavement surface and affected base/sub base layers.
- Placement and compaction of new base/sub base layers.
- Application of tack coat along the edges of the repair area.
- Placement and compaction of new asphalt surface.

The main materials used for dig outs are:

- Hot-mix asphalt (HMA) - preferred
- Cold-mix asphalt – emergency fix only
- Granular base course – for remote areas or low volume roads

1.3 PAVEMENT EDGE REPAIRS

Edge repairs are used when the pavement has failed along the edges due to the action of traffic and the loss of edge support that occurs due to the presence of water, aggressive-growth vegetation, and wind from either traffic or the atmosphere. The main materials and methods used in edge repairs are the same as those associated with patching and dig outs.

1.4 SURFACE REINSTATEMENT

The main method used for surface reinstatement is skin patching. Skin patching does not require a dig out. Typically, either a thin layer of HMA or a cold mix blanket can be applied to the existing surface or a coat of spray binder (emulsion) is applied and covered with a layer of aggregate. Aggregate is either washed sand or fine aggregate [3 to 5 mm (0.1 to 0.2 in)] compatible with the emulsion being used. HMA skin patches are rolled with a light or hand roller, while spray-on patching is rolled using the maintenance truck wheels.

2.0 PROJECT SELECTION

2.1 POTHOLES

Potholes are a form of disintegration of the pavement that may be associated with poorly compacted material, raveling, cracking, base failure or aging of the pavement. Potholes often appear after rain or during thaw periods when pavements are weaker. The generally accepted mechanisms for pothole formation are as follows:

- Raveling, stripping, or cracking in the pavement surface.
- Water penetrates the surface layers of the pavement, softening the underlying pavement layers, which increases deflections. Figure 1 illustrates how water can penetrate a pavement.
- Ice formation and heaving in the pavement occurs in some climatic areas. Figure 2 illustrates heaving due to a freeze-thaw cycle in a cold climate.
- Fines from the underlying pavement layers are lost, reducing overall structural strength and support for the pavement surface. Figure 3 illustrates the resulting cavity when the fines are lost due to migration or pumping.
- Once a hole is formed, it will continue to grow until it is repaired. Figure 4 illustrates the role traffic plays in enlarging a pothole.

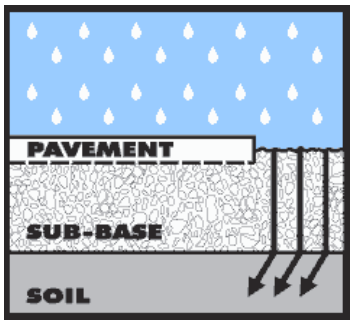

Figure 1: Water Penetration of Pavement (1)

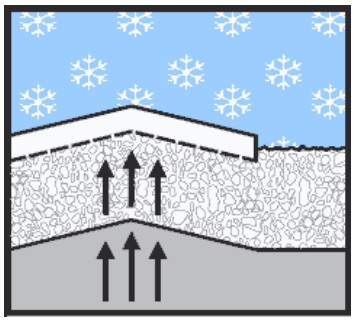

Figure 2: Heaving Effects Caused by the Freeze/Thaw Cycle (1)

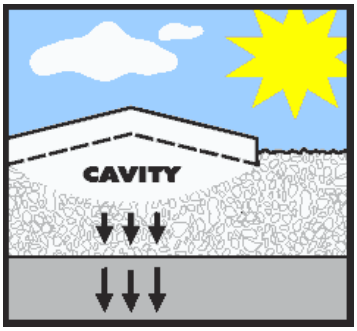

Figure 3: Loss of Fines Results in a Void Under the Pavement (1)

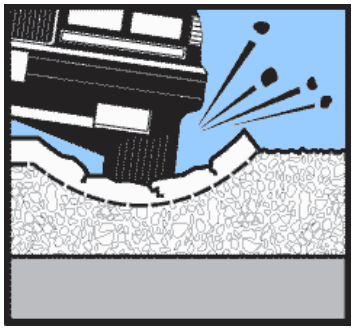

Figure 4: Once Formed, Traffic Enlarges Potholes (1)

2.2 EDGE FAILURE

Edge failures occur when the edge of a pavement breaks up. This failure is caused by traffic loading at the edge of the pavement (usually due to a horizontal geometry problem) and/or the infiltration of water at the edges of the pavement or shoulder. Although edge failures are usually out of the primary wheel paths, their presence can accelerate the normal deterioration of the pavement in the traveled way.

2.3 COSTS AND PERFORMANCE

The main costs associated with patching include:

- Labor
- Materials
- Equipment
- Traffic Delays

Cost effectiveness is determined by the patch survival rate. To determine the patch survival rate, repairs should be monitored for at least one year. Monitoring consists of checking for the presence of repairs and noting the survival or failure of each pavement section. Figure 5 shows typical survival rate curves, where A, B and C represent three separate patch locations. The area under the curve represents the patch survival rate.

Dig outs are generally carried out using larger equipment and are the most expensive method of patching. The effectiveness of dig outs is determined in the same manner as described for patching above.

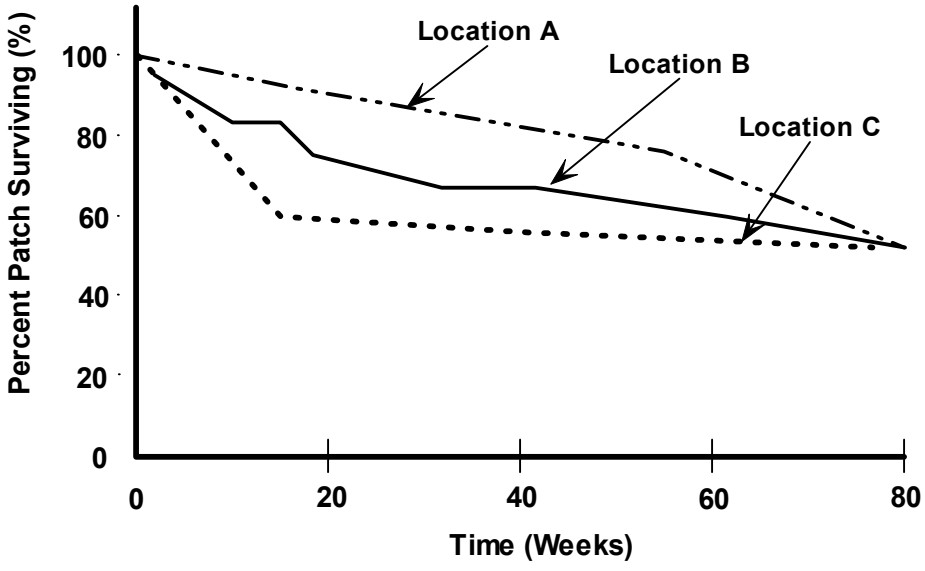

Figure 5: Typical Survival Rate Curves (2)

2.4 DESIGN AND SPECIFICATION

Patching design and specification is based on procedures of application and the use of appropriate materials. The materials should be tested according to the related specifications. Generally HMA materials are specified based on Caltrans Dense-Graded Asphalt Concrete (DGAC) specifications as presented in Standard Specifications Section 39 (3). However, the mix type used may vary according to traffic conditions.

Caltrans also uses cold-mixes for patching. These are generally proprietary products and should be handled according to the manufacturer's specifications.

3.0 CONSTRUCTION PROCEDURES

3.1 POTHOLE PATCHING

Construction procedures for pothole patching vary according to the method and materials selected. The three primary patching techniques along with edge sealing technique are described below. Appendix A, "Suggested Field Considerations", at the end of this chapter, provides a series of tables to guide project personnel through the important aspects of performing a patching or edge repair project.

3.1.1 Throw and Roll

The "throw and roll" method is often used for temporary patches. This is only appropriate when weather conditions are too poor for a semi-permanent patch to be placed or the road is due to be rehabilitated soon. It is the most inexpensive and least labor-intensive method for patching a pothole and includes the following steps. Figure 6 illustrates a typical throw and roll application.

- Patching material is placed into the hole, with or without cleaning and/or drying of the hole.
- The material is compacted using the maintenance truck tires.
- The finished patch should have 3 to 6 mm (1/8 to ¼ in) of crown to help avoid water ponding.
- Clean up is generally not required.

Figure 6: Throw and Roll Patching

3.1.2 Semi-Permanent Patches

Semi-permanent patching is considered to be an effective patching method (second only to complete removal and replacement of the failed area). The following steps describe how this form of patching is carried out:

- Mark the boundaries of the distressed area, taking care to encompass a slightly larger area than that reflected by the distress. The repair boundaries should be as rectangular as possible and take into consideration the dimensions of the equipment that will be used for removal of the old material and compaction of the new material.

- Cut the boundaries of the patch square using either a diamond saw or pneumatic hammer with a spade bit. In the case of the latter, care should be taken not to damage the HMA surface layer in the sound pavement.

- Remove water and debris from the hole. Figure 7 illustrates a hole that has been dewatered and cleaned of debris. Depending on the size of the pothole, this may be accomplished manually with a pick and shovel or with various combinations of power equipment, i.e., a pneumatic hammer and shovel, backhoe, or front-end loader. Cold milling equipment can also be very effective for this operation.

- Square up the sides of the hole until the edges of the hole are sound pavement. This step is usually very simple if the boundaries of the repair area were cut with a diamond saw or established with cold milling equipment. It is usually only required when manual techniques of material removal are employed. Figure 8 illustrates a hole that has been extended to sound pavement and firm supporting material. It is suggested that the depth of the patch be 50% thicker than the thickness of the failed layer.

- Apply a tack coat of asphalt emulsion to the sides and bottom of the hole at a rate of approximately 1 liter/m^2 (0.2 gal/yd^2) of slow or rapid setting emulsion. The tack coat should either be sprayed or brushed on the edges of the repair, never poured. Figure 9 illustrates the tack coat application.

- Place the patch material in the hole. If the patch is placed manually, use a shovel (*not a rake*) to place the HMA material taking care to avoid segregation. The hole should be overfilled by 20 to 25 percent of its depth to provide adequate material for compaction. An asphalt rake should be used to feather or blend the patch edges.

- Compact the patch material with a hand device or a small vibratory roller. It is preferable to use compaction equipment whose surface is smaller than the size of the patch. It is very difficult to achieve satisfactory compaction with equipment that bridges the repair area. Figure 10 illustrates the compaction of the patch material.

- The finished patch should have a 3 to 6 mm (0.1 to 0.2 in) crown. This allows for further compaction by traffic and helps prevent standing water in the patch area. Figure 11 illustrates the finished patch.

- The patched area should be seamed with crack sealant and fog sealed.

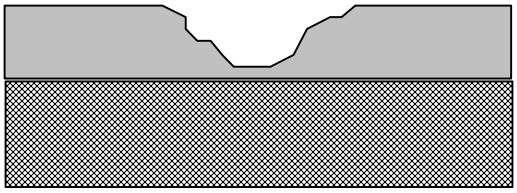

Figure 7: Dewatered and Cleaned Pothole (4)

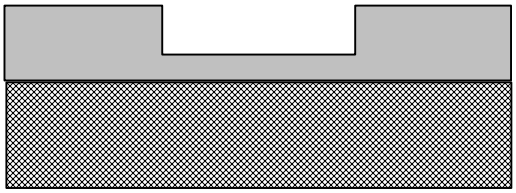

Figure 8: Surface and Base of Pothole Prepared for Treatment (4)

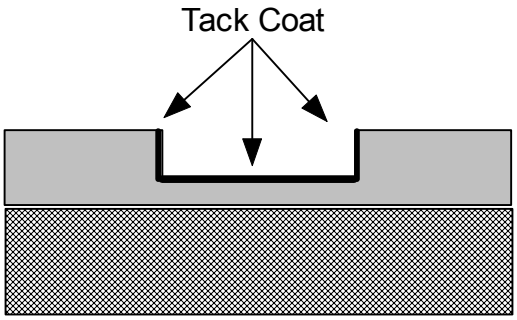

Figure 9: Tack Coat Applied to All Sides of Hole (4)

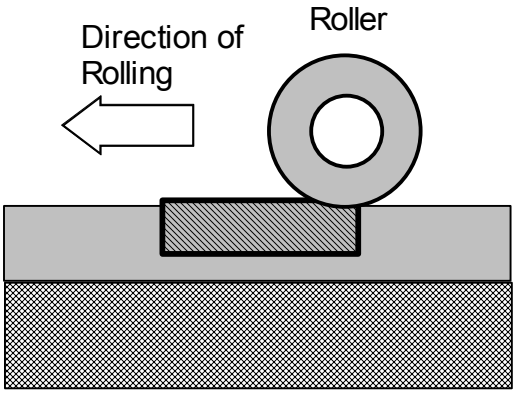

Figure 10: Patch Material Placed and Compaction in Progress (4)

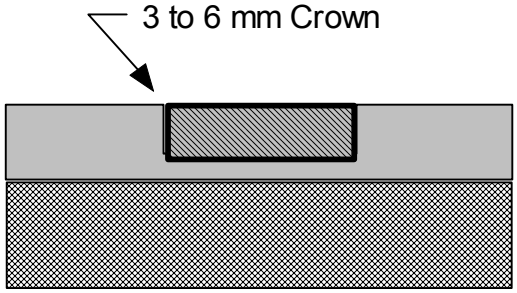

Figure 11: Finished Patch with a 3 to 6 mm Crown (4)

3.1.3 Injection Patching

Injection patching is a rapid and effective method of patching that requires specialized equipment. This method, not currently used by Caltrans, is used for lower trafficked roads and is an alternative to the throw and roll method. These patches are temporary, but generally have a longer life than throw and roll patches (5). The steps for injection patching are described below:

- Prepare the site for patching by blowing debris and water from the hole with the application nozzle. Figure 12 illustrates site preparation.
- Spray a tack coat of emulsion on the sides and bottom of the hole at a rate of approximately 1 liter/m^2 (0.2 gal/yd^2). Figure 13 illustrates the application of a tack coat.

- Blow asphalt/aggregate mixture into the hole, filling the hole to the top. Figure 14 illustrates filling the prepared hole.
- Finish with a layer of dry aggregate. Figure 15 illustrates the application of a finish coat to minimize pick up. Note: It is not necessary to roll a pothole patched using this method. This is one advantage to the injection method.

Figure 12: Site Preparation

Figure 13: Application of Tack Coat

Figure 14: Filling the Prepared Hole

Figure 15: Application of Finish Coat

3.1.4 Edge Sealing

To improve the durability of a patch, the edge of the patch should be sealed to prevent the intrusion of water and other debris. Edge sealing refers to the application of asphaltic material along the edges of a patch. Once set, this ensures that water cannot penetrate the patch seam. Sealing materials may be rubberized to allow for differential movement between the existing pavement material and the new patch material. Figure 16 illustrates a finished edge seal application.

Figure 16: Edge Seal Application

3.2 DIG OUTS AND EDGE REPAIRS

When the edge of the pavement has broken away or the base has failed due to severe alligator cracking, the complete removal (dig out) of failed asphalt and base materials is typically required. Dig out selection is important, as areas that fail due to alligator cracking will produce reflective cracks through new surface treatments if the distressed pavement is not replaced. When in doubt, a dig out should be performed.

3.2.1 Dig Outs

The typical dig out construction process is as follows:

- Mark the boundaries of the distressed area to be replaced. Strive for rectangular areas taking into consideration the dimensions of the equipment that will be used for removal of the failed material and compaction of the new material.
- Cut out the perimeter of the area with a diamond saw or cold milling machine.
- Break up and remove the failed pavement to the subgrade material using appropriate combinations of pneumatic hammers, backhoes, front-end loaders, and cold milling equipment.
- Clean and dry the dig out area.
- Place and compact new (virgin) base course material using appropriate combinations of front-end loaders and roller compaction equipment. The finished base course surface should typically be 25 mm (1 in) below the original base course surface. This provides for a thicker and more stable patch.
- Apply a tack coat of emulsion at a rate of approximately 1 liter/m^2 (0.2 gal/yd^2) to the sides of the repair area. Tack may also be placed along the bottom of the repair area if local experience indicates good performance. Place the patch material in the prepared dig out area.
- Generally larger aggregates 12 to 19 mm (1/2 to ¾ in) are used for dig outs because of their thickness. Place the patch material in the prepared dig out area. *Note: HMA is typically used as the patch material (AR-4000 with 9mm aggregate. AR-8000 should be used if the area has a history of pushing or shoving.).*
- The patch material is typically placed in lifts if the depth of the repair is greater than 100 mm (4 in). The thickness of any lift should not exceed 100 mm (4 in). The final lift should be made using enough material that 3 to 4 roller passes are required to roll the patch flush with the old pavement.

- Compact each lift using equipment similar to that typically used in hot-mix asphalt compaction operations. The width of the compaction equipment should be narrow enough to fit within the repair area. Equipment that bridges the repair area is less likely to achieve adequate compaction of the HMA material (Note: Caltrans allows wheel rolling in all lifts except the top lift).
- The finished patched area should have a crown of 3 to 6 mm (1/8 to ¼ in).

Figure 17 illustrates a completed dig out project. Before the new pavement is open to traffic, it is recommended that the edges are seamed with crack sealant and the entire patch is fog sealed.

Figure 17: Dig Out Project

3.2.2 Edge Repair

The basic construction steps associated with a repair along the edge of the pavement depend upon the severity and depth of the deterioration. If the distress is confined mainly to the HMA surface, then the steps associated with a regular patching operation should be employed. If, on the other hand, the deterioration extends well below the surface, then the steps associated with a dig out are more appropriate. In both cases, the intent is to provide improved lateral support along the pavement's edge. Accordingly, extra precautions should be taken for achieving adequate compaction and maintaining good drainage at that interface with the shoulder.

3.3 SKIN PATCHING (SURFACE REINSTATEMENT)

Choosing the appropriate skin patching method depends largely on what materials are available. Table 1 summarizes three typical approaches.

4.0 TROUBLESHOOTING

This section provides information to assist maintenance personnel with troubleshooting problems with patching and edge repair projects. Table 2 outlines common problems and related solutions.

Table 1: Approaches for Surface Reinstatement

METHOD A: HMA APPLICATION
• The area to be patched is cleaned of debris. • A diluted tack coat emulsion is applied at a rate of approximately 0.5 l/m^2 (0.1 g/yd^2) • The HMA is laid over the surface and spread. The HMA should be spread to a minimum of twice the thickness of the largest aggregate size. • The HMA is then compacted using a pneumatic tired roller and possibly a steel wheel finish roller. A vibratory roller is not recommended because of the possibility of crushing aggregate in thin lifts.
METHOD B: EMULSION SEAL COAT
• The area to be patched is cleaned of debris. • A tack coat emulsion is applied at a rate of approximately 1 l/m^2 (0.2 g/yd^2). • A layer of sand or fine aggregate, typically 3 to 5 mm (0.1 to 0.2 in) in depth, is applied. • The patched area is then rolled with a pneumatic tired roller.
METHOD C: COLD MIX
• The area to be patched is cleaned of debris. • A light tack coat of diluted emulsion is applied at a rate of approximately 0.5 l/m^2 (0.1 g/yd^2). • Spread mix over area to be repaired to a depth of 25mm (1 in). • Compact mix using a pneumatic tire roller (or haul trucks) and finish with a steel wheel roller. • Follow up before winter with a fog seal.

Table 2: Common Patching Problems and Related Solutions

PROBLEM	SOLUTION
PATCHING MATERIAL PICKS OUT	• Ensure the hole is cleaned properly and not too wet. • Ensure sufficient tack coat is applied. • Use a self-setting cold-mix when holes cannot be dried properly. • Ensure the patch is solid before trafficking. • Dust patch surface with sand or small aggregate. • Wait for better weather. • Do not use cutback based cold-mix (unless a temporary repair is being done). • For HMA patches, allow to cool before traffic is allowed over the patch. • Ensure required compaction is achieved.
FLUSH SURFACE	• Reduce asphalt or emulsion content in the mix. • Reduce tack coat application. • Allow longer time before trafficking. • Ensure the gradation of the aggregate is appropriate.
UNEVEN SURFACE	• Ensure cold-mix is workable. • Ensure HMA is at the right temperature for placement and compaction. • Ensure adequate compaction is achieved.
LOSS OF COVER ROCK IN SEAL COAT PATCHES	• Ensure surface is clean. • Ensure correct emulsion content is sprayed. • Ensure aggregate is spread while the emulsion is still brown. • Ensure emulsion is broken before traffic is allowed. • Allow longer cure time before traffic.
TRAFFIC COMPACTS MIX TO BELOW EDGE OF HOLE	• Ensure finished hole is overfilled 3 to 6 mm (0.1 to 0.2 in). • Ensure adequate compaction is achieved. • Ensure mix is workable at application temperatures. • Allow longer time before trafficking.

5.0 REFERENCES

1. "Birth of a Pothole", http://www.dot.state.mn.us/information/potholes/michdot/michdotpotholes.html.

2. Federal Highway Administration, U.S. Department of Transportation, "Materials and Procedures for Repair of Potholes in Asphalt- Surface Pavements", FHWA-RD-99-168, Washington, DC, 1999.

3. California Department of Transportation, "Standard Specifications", Section 39, Sacramento, CA, 1999.

4. Asphalt Emulsion Manufacturers Association, "A Basic Asphalt Emulsion Manual", Annapolis, MD, 1998.

5. Strategic Highway Research Program, "Distress Identification Manual for the Long-Term Pavement Performance Project", SHRP-P-338, Washington, DC, 1993.

6. Asphalt Institute, "Pavement Maintenance Techniques", Manual Series MS-3, Lexington, KY, 1995.

7. The Asphalt Institute, "A Basic Asphalt Emulsion Manual", Manual Series No. 19, Lexington, KY, 1999.

APPENDIX A

SUGGESTED FIELD CONSIDERATIONS FOR PATCHING & EDGE REPAIR

The following field considerations are a guide through the important aspects of performing a patching or edge repair project. The various tables contain items that should be considered in order to promote a successful job outcome. Thorough answers to these questions should be determined, as required, before, during, and after construction. The appropriate staff to do this will vary by job type and size. Some topics may need attention from several staff members. The contractor or maintenance field supervisor should be acquainted with its contents. The intent of the tables is not to form a report, but to bring attention to important aspects and components of the project process. Some information is product specific and contained in the relevant standard specifications, standard special provisions, or special provisions.

PRELIMINARY RESPONSIBILITIES	
PROJECT REVIEW	▪ What is the extent of the potholes? ▪ What caused them? ▪ Is base failure extensive? ▪ Are pothole patches or dig outs required? ▪ Will a surface treatment be needed after the repair? ▪ What is the traffic level? ▪ Is the majority of the base sound and well drained? ▪ What time of year will repairs be performed? ▪ Is a temporary or permanent patch required? ▪ Will the patch require an edge seal? ▪ Review project for quantities of materials required.
DOCUMENT REVIEW	▪ Material specifications. ▪ Dig out / patching methods. ▪ Required special provisions. ▪ Construction manual. ▪ Traffic control plan (TCP).
MATERIAL CHECKS	
EMULSION INJECTION OR COLD-MIX PATCHING	▪ Are the materials compatible with the job requirements? ▪ Is the emulsion produced by an approved source? ▪ Has the delivered emulsion been sampled and submitted for testing? ▪ Does the aggregate meet all specifications and is clean and free of deleterious materials (sand equivalent)? ▪ Is the aggregate damp, but not wet? ▪ Is the emulsion warm to the touch but not hot? ▪ Is the tack emulsion suitable for the climatic conditions? ▪ Is the cold-mix within specifications? ▪ Is the cold-mix workable at the required temperatures?

MATERIAL CHECKS	
SPECIAL COLD-MIX PATCHING	▪ Are materials compatible with the job requirements? ▪ Are the materials within specification? ▪ Is the tack emulsion within specification?
HMA PATCHING	▪ Are the materials compatible with the job requirements? ▪ Is the tack emulsion produced by an approved source? ▪ Has the delivered emulsion been sampled and submitted for testing? ▪ Is the HMA made to specification? ▪ Is the HMA workable in the climatic conditions used?
DIG OUTS AND EDGE REPAIRS	▪ Are the materials compatible with requirements? ▪ Is the emulsion produced by an approved source? ▪ Has the delivered emulsion been sampled and submitted for testing? ▪ Is the mix used for reinstatement within specification? ▪ Is the base course material within specification?
SKIN PATCHING	▪ Are the materials compatible with requirements? ▪ Is the emulsion produced by an approved source? ▪ Has the delivered emulsion been sampled and submitted for testing? ▪ Is the aggregate clean, dry, and properly graded? ▪ Is the base course material within specification?
PRE-SEAL INSPECTION RESPONSIBILITIES	
SURFACE PREPARATION	▪ Are the edges of potholes or dig outs straight and free of debris? ▪ Has the existing surface been inspected for drainage problems? ▪ For dig outs, has all failed material been removed?
EQUIPMENT INSPECTIONS	
INJECTION PATCHING MACHINE	▪ Is the machine fully functional? ▪ Is the equipment free of leaks (hydraulic oil, diesel, motor oil, etc)? ▪ Does the aggregate flow freely? ▪ Does the emulsion flow freely? ▪ Is the compressor working properly?
DIG OUT COLD PLANERS	▪ Is the machine fully functional? ▪ Are the cutting tips sharp and do they make a clean cut without spalling the edges? ▪ Is the equipment free of leaks (hydraulic oil, diesel, motor oil etc)?

EQUIPMENT INSPECTIONS	
POTHOLE PATCHERS – HMA/COLD-MIX	▪ Is the equipment free of leaks (hydraulic oil, diesel, motor oil etc)? ▪ Are heating systems working and able to accurately control mixing temperature? ▪ Are all conveyors working? ▪ Are the hoses for applying tack coat working properly? Is the tack coat being applied at the correct rate?
SKIN PATCHING	▪ Is the equipment free of leaks (hydraulic oil, diesel, motor oil etc)? ▪ Are the heating systems working and accurately controlling the mix temperature? ▪ Can the hand spray line or boot truck spray be properly controlled? ▪ Is aggregate spreading being properly controlled?
COMPACTION DEVICES	▪ Is the equipment free of leaks (hydraulic oil, diesel, motor oil etc)? ▪ Are tandem or other rollers in working order and meet specification requirements? ▪ Are compaction measurement devices (such as nuclear gages) in working order?
WEATHER REQUIREMENTS	▪ Have the air and surface temperatures been checked at the coolest location on the project and do they meet agency requirements. ▪ Application of patching does not begin if rain or snow is likely. ▪ Emulsion type applications should not start if freezing temperatures are expected.
TRAFFIC CONTROL	▪ The signs and devices used match the traffic control plan. ▪ The work zone complies with Caltrans requirements. ▪ Flaggers do not hold the traffic for extended periods of time. ▪ Signs are removed or covered when they no long apply.

PROJECT INSPECTION RESPONSIBILITIES	
INJECTION PATCHING	▪ Does the operator have the correct safety equipment? ▪ Is the weather going to be fair and above freezing for at least 48 hours after patching? ▪ Is the aggregate and emulsion within specification? ▪ Is there enough emulsion and aggregate available? Is the aggregate clean and dry and within specification? ▪ Are the holes to be patched in a stable pavement? Are they dry? ▪ Do the holes have vertical and clean sides? ▪ Is the tack coat applied evenly and only 1 mm (0.04 in) thick? ▪ Does the aggregate flow evenly into the hole? ▪ Does the emulsion evenly coat the aggregate? ▪ Is the hole finished with a layer of aggregate? ▪ Does the mixture show signs of curing (turn black) within the first 10 minutes? ▪ Is the application is stopped as soon as any problems are detected? ▪ Does the application of the patching material appear uniform? ▪ Does the surface have an even and uniform texture? ▪ Check application rate based on amounts of aggregate and emulsion used. ▪ What is the time between spreading and opening to traffic? ▪ Adjust work time, emulsion level, or mixture temperature to allow opening to traffic.
COLD-MIX PATCHING: THROW AND GO	▪ Does the operator have the correct safety equipment? ▪ Is the weather going to be fair and above freezing for at least 48 hours after patching? ▪ Is the mix and tack emulsion within specification? ▪ Is there enough emulsion and mixture available? Is the mixture workable at the temperatures of application? ▪ Are the holes to be patched in a stable pavement? Are they dry? Is there debris in the hole? ▪ Is the tack coat sprayed evenly and no more than 1 mm thick? ▪ Does the mix fill the holes evenly? ▪ Are multiple lifts required, hole depth > 100 mm (4 in)? ▪ Finished patches should be slightly crowned to allow for secondary compaction produced by traffic. ▪ Does the mixture compact satisfactorily? ▪ Is the surface finish even and uniform? ▪ Do tires pick up the final surface? If so, dust with aggregate or sand.

PROJECT INSPECTION RESPONSIBILITIES	
COLD-MIX PATCHING: DIG OUTS AND EDGE REPAIRS	▪ Does the operator have the correct safety equipment? ▪ Is the weather going to be fair and above freezing for at least 48 hours after patching? ▪ Is the mix and tack emulsion within specification? ▪ Is there enough emulsion and mixture available? Is the mixture workable at the temperatures anticipated during application? ▪ Are the holes to be patched in clean, dry, and in a stable pavement? ▪ For edge repairs, is the pavement edge clean and not spalled? ▪ Is the tack coat sprayed evenly and no more than 1 mm (0.04 in) thick? ▪ Does the mix fill the holes evenly? ▪ Are multiple lifts required, hole depth > 100mm (4 in)? ▪ Finished patches should be slightly crowned to allow for secondary compaction produced by traffic. ▪ Does the mixture compact satisfactorily? ▪ Do the rollers allow a good surface profile? ▪ Is the surface finish even and uniform? ▪ Do tires pick up the final surface? If so, dust with aggregate or sand.
HMA PATCHING: THROW AND GO	▪ Does the operator have the correct safety equipment? ▪ Is the weather going to be fair and above freezing for at least 48 hours after patching? ▪ Is the mix and tack emulsion within specification? ▪ Is there enough emulsion and mixture available? Is the mixture workable at the temperatures of application? ▪ Are the holes to be patched in clean, dry, condition? Are they in a stable pavement? ▪ Is the tack coat sprayed evenly and no more than 1 mm (0.04 in) thick? ▪ Does the mix fill the holes evenly? ▪ Are multiple lifts required, hole depth > 100 mm (4 in)? ▪ Finished patches should be slightly crowned to allow for secondary traffic compaction. ▪ Does the mixture compact satisfactorily? ▪ Is the surface finish even and uniform? ▪ Do tires pick up the final surface? If so, dust with aggregate or sand.

PROJECT INSPECTION RESPONSIBILITIES	
HMA PATCHING: DIG OUTS AND EDGE REPAIRS	▪ Does the operator have the correct safety equipment? ▪ Is the weather going to be fair and above freezing for at least 48 hours after patching? ▪ Is the mix and tack emulsion within specification? ▪ Is there enough emulsion and mixture available? Is the mixture workable at the temperatures of application? Is the mix hot enough? ▪ Where a pothole-patching machine is being used does it keep the mix hot without degrading it? ▪ Are the holes to be patched in clean, dry condition? Are they in a stable pavement? ▪ For edge repairs and dig outs are the edges straight and not spalled? ▪ Is the tack coat sprayed evenly and no more than 1 mm thick? ▪ Does the mix fill the holes evenly? ▪ Are multiple lifts required, hole depth > 100 mm (4 in)? ▪ Finished patches should be slightly crowned to allow for secondary compaction produced by traffic. ▪ Does the mixture compact satisfactorily? ▪ Is the surface finish even and uniform? ▪ Do tires pick up the final surface? If so, dust with aggregate or sand.
SKIN PATCHING	▪ Does the operator have the correct safety equipment? ▪ Is the weather going to be fair and above freezing for at least 48 hours after patching? ▪ Is the emulsion within specification? ▪ Is the aggregate clean and dry and within specification? ▪ Is there enough emulsion and aggregate available? ▪ Are the holes to be patched in clean, dry condition? Are they in a stable pavement? ▪ Is the emulsion sprayed evenly and no more than 1 to 2 mm (0.04 to 0.08 in) thick? ▪ Is the aggregate spread evenly over the road surface? ▪ Is the surface finish even and uniform? ▪ Do tires pick up the final surface? If so, dust with aggregate or sand.
ROLLING: (WHEN REQUIRED)	▪ Is the patch stable before rolling begins? ▪ Is the entire surface rolled only once? ▪ Do the rollers travel slowly—8 kph (5 mph) maximum. Do they pick up or tear the mat? ▪ Joints and overlaps may require extra passes in parking lot work especially.

PROJECT INSPECTION RESPONSIBILITIES	
CRACK SEALING	▪ Crack seal all seams ▪ Fog seal patch surface
OPENING THE PATCHING TO TRAFFIC	▪ The traffic travels slowly—40 kph (25 mph) or less—over the fresh patches. ▪ Reduced speed limit signs should be used when pilot cars are not used. ▪ Remove all construction related signs when opening to normal traffic.
CLEAN UP	▪ All loose patching material should be removed from the travel way. ▪ Remove binder application or spills from all areas including curbs, sidewalks and radius applications.